

REMARKS

Claims 16-26 are now active in the application.

As noted in the response to Non-Final Office Action filed September 12, 2006 (incorporated herein by reference), the present application relates to a method of operating a plating bath such that the number of voids in the plated metal is minimized. The method involves first plating a metal on a substrate in a plating bath containing an accelerator. Then an accelerator breakdown product concentration and remaining accelerator concentration is measured along with the number of voids in the plated metal. This process is repeated and the relative concentration of accelerator breakdown product to accelerator concentration (VFM ratio) is then determined as a function of the number of voids in the plated metal.

The plating bath is then operated at a VFM ratio below the highest VFM ratio at which no voids are observed. The results of this process are illustrated in Fig. 4 of the specification where the number of voids as a function of the VFM ratio is plotted. The method provides for a convenient method of operating a plating bath while minimizing the number of metal voids. Applicants have found that the relative concentration of accelerator breakdown product to accelerator determines the number of metal voids in a plating process. This process provides for an improvement over traditional methods which seek to improve plating operations by controlling a single variable which is typically the absolute concentration of by-product contaminants in the plating bath. This allows for more efficient and economical use of plating bath accelerants.

In response to Applicants' response filed September 12, 2006, the Office has maintained the rejection of the claims 16 -26 under 35 U.S.C. §103(a) over the combination of Seita (U.S. Patent No. 6,881,319), Chalyt (U.S. Patent No. 6,749,739), Blachier (U.S. Patent No. 6,569,307) and Kopp (U.S. Patent No. 6,083,374). The cited references fail to render obvious claims 16-26.

In the Final Office Action mailed November 15, 2006, the Office maintains that Chalyt teaches or suggests measuring the plating bath concentration of at least one acceleration breakdown product and measuring the bath concentration of at least one accelerator and utilizing the ratio of these components (VFM ratio) to eliminate voids in metal plated on a substrate in a plating bath. The claimed method measures both the accelerator concentration and corresponding accelerator breakdown product. Chalyt nor any of the other cited references teach or suggest this claim element.

In the Office Action, the Office states that Applicants argue that "a. Chalyt et al. describes a qualitative process of determining a VFM ratio not a quantitative process as claimed." Applicants' respectfully disagree with this characterization of the Applicants statements (in response filed September 12, 2006). The Applicants actually stated that Chalyt only qualitatively measures the build up of low molecular weight glycols which are a breakdown formed from high molecular weight glycols in the plating bath.

Chalyt qualitatively measures only the breakdown products and does not measure the original (non-breakdown) products. The qualitative measurement is made by measuring the CVS endpoint volume fraction at -0.225 V and -0.400 V. When the ratio of the CVS endpoint volume fraction between these two voltages is high (greater than 1) it is qualitatively known that there is a build up of low molecular weight glycol breakdown products in the plating bath. This measurement only produces useful data for the breakdown product not the starting product.

The only thing that is known from this technique is that some breakdown product has formed. This technique is not quantitative and it does not even qualitatively measure the original product throughout the plating process at all. Indeed, Chalyt states that

"Although the difference parameter has concentration units, this has little meaning with respect to the absolute concentration of the suppressor breakdown contaminants, which are typically comprised of polymer chains of varying lengths. Consequently, calibration curves for suppressor breakdown contaminants are of limited use for process control.

Typically, the value of a relative concentration parameter determined by the method of

the present invention is correlated with the deposit quality so as to define an acceptable relative contaminant concentration range for the specific plating process.” (column 7, lines 25-47)

Chalyt is simply qualitatively determining that breakdown product has formed and uses that information to control plating bath conditions. Chalyt is not measuring both the original concentration and the breakdown product concentration as claimed. The “relative concentration parameter” that Chalyt is discussing is the relative CVS endpoint volume fraction measurement of only the breakdown product at two voltages. In other words, Chalyt is controlling the process based on an approximate maximum decomposition product concentration not a ratio of both original product and decomposition product.

This can be seen by inspection of Figure 1. At high PEG molecular weights (4000-8000) the CVS endpoint volume fraction at -0.225 V and -0.400 V is essentially the same giving a ratio of about 1. As the high molecular weight PEG product decomposes to below a molecular weight of about 2000 a difference in the endpoint volume fraction is observed. The ratio of these endpoint volumes gives a qualitative measurement of the breakdown products. The detection of only the breakdown product controls the process in Chalyt. The method described in Chalyt does not quantitatively measure both the original plating bath component (high MW PEG) and the breakdown products (low MW PEG) and then utilize this quantitatively measured ratio to control plating bath operations.

Again, Applicants reiterate that the ratio discussed in Chalyt is only the endpoint volume fraction ratio determined from two different voltages from the decomposition product only. This is not the VFM ratio as claimed by the Applicants as the Office has suggested. Chalyt does not provide for a measurement of the concentration of high MW PEG starting materials or even intermediate MW PEG (2000-4000 MW) formed during the decomposition process. Chalyt only describes a method for the detection of suppressor breakdown products as the title of Chalyt suggests.

Accordingly, Chalyt does not teach or suggest the claimed method. In addition, the combination of Chalyt with the other cited references does not teach or suggest the claimed method; and therefore, Applicants respectfully request that the Examiner withdraw the rejections under 35 U.S.C. §103(a).

In light of the remarks contained herein, Applicants submit that the application is in condition for allowance. Favorable reconsideration is respectfully requested.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 50-0510, under Order No. 20140-00302-US from which the undersigned is authorized to draw.

Dated: December 22, 2006

Respectfully submitted,

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